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## **Inclusion of Engineering Concepts in Middle and High School Science Textbooks**

### **Methods**

A two pronged approach was used. First, a literature search of published papers and textbook reviews was utilized to summarize previous findings and to verify the publishers of the most commonly used physics textbooks for grades 9-12. Second, a cursory review was done of all the science textbooks published by these publishers. This review examined each publisher's description of their texts, and the table of contents of each text, for any obvious inclusion of engineering principles/content.

### **Summary of Findings**

The literature review found that no significant engineering concepts are included in any commonly used science textbook.<sup>1</sup> Further, several groups critically analyzing science textbooks have found high school textbooks to be generally lacking in terms of usefulness.<sup>2</sup> In particular, they cover too many topics with not enough depth.<sup>3</sup>

A brief review of the science textbooks published by the 4 most commonly used publishers<sup>4</sup> revealed little engineering inclusion. Bear in mind this conclusion is based only on information gleaned from the publishers' websites. In many cases this information consisted of only a brief description of the text and a table of contents. Of the 96 textbooks surveyed 20 contained topics that were possibly, at least tangentially, related to engineering. Further in-depth review of these 20 books is recommended in order to determine the extent to which engineering concepts may or may not be included. The books, and the corresponding topics/sections, are grouped by publisher and listed in the attached tables.

In general, science textbooks, at both the middle school and high school level do not include specifically engineering related content nor do they strongly relate the science concepts to engineering. However, in the course of this research, a few textbooks solely intended for use in high school introductory engineering courses were discovered. A list of these is included.

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<sup>1</sup> Cantrell, P and Robinson, M. How do 4<sup>th</sup> through 12<sup>th</sup> Grade Science Textbooks Address Applications in Engineering and Technology? <http://bst.sagepub.com/cgi/content/abstract/22/1/31>

<sup>2</sup> Project 2061. Middle Grades Science Textbooks: A Benchmarks-Based Evaluation. <http://www.project2061.org/publications/textbook/mgsci/summary/default.htm>

<sup>3</sup>U.S. National Research Center for the Third International Mathematics and Science Study. A Splintered Vision: An Investigation of U.S. Science and Mathematics Education. <http://hub.mspnet.org/index.cfm/9109>

<sup>4</sup>2001 Nationwide Survey of High School Physics Teachers. High School Physics at the Turn of a New Century. <http://www.aip.org/statistics/texts/hsttext.htm>

## Textbooks with possible Engineering Content

<u><a href="#">Glencoe/McGraw-Hill/Merrill Co</a></u>	
Textbook	Section/Topic
Human Genetics: Concepts and Applications (Lewis) 2005	Chapter 19 Genetic Technologies: Amplifying, Modifying, and Monitoring DNA
Chemistry (Silberberg) 2006	12.7 Advanced Materials: Nanotechnology: Designing Materials Atom by Atom
Chemistry (Silberberg) 2006	13.7 Chemical Connections in Sanitary Engineering: Solutions and Colloids in Water Purification
Electricity and Magnetism 2005 (part of a 15 book series for middle school science)	Chapter 3: Electronics and Computers
Introduction to Physical Science 2005	Unit 7 Electricity and Magnetism: Electronics and Computers
Glencoe Physical Science with Earth Science 2006	Unit 1 Science and Technology: Science, Technology, and Society

<u><a href="#">Holt, Rinehart and Winston, Inc.</a></u>	
Textbook	Section/Topic
Science & Technology: Physical Science	Chapter 19: Electronic Technology
SciencePlus Technology and Society: Green	Chapter 3 From Science to Technology
SciencePlus Technology and Society: Red	Unit 5 Structures and Design: Chapter 14 The Science of Structure Chapter 15 The Art of Design
Biology: Principles & Explorations	Chapter 11 Gene Technology
Holt Biology: Visualizing Life	Chapter 9 Gene Technology
Holt Physics	Chapter 24 Modern Electronics: Section 24.1: Conduction in the solid state Section 24.2: Semiconductor applications

<u><a href="#">Prentice Hall</a></u>	
Textbook	Section/Topic
Chemistry	Science & Technology Inserts
Biology	Chapter 13: Genetic Engineering

<b><u>McDougal Littell</u></b>	
<b>Textbook</b>	<b>Section/Topic</b>
Middle School Modules (Supplement to Modules)	Understanding Technological Design
McDougal Littell Physical Science	Unit 1 Section 3.3: Technology improves the ways people use energy Unit 3 Section 5.3: Design a Machine Unit 5 Section 2.3: Design an Electronic Communication Device
McDougal Littell Earth Science	Unit 1 Section 1.1: Technology is used to explore the Earth System Section 1.4: Technology is used to map Earth
McDougal Littell Life Science	Unit 1 Section 5.3: Modern Genetics Uses DNA Technology
McDougal Littell Science Integrated Course 1	Unit 1 Section 1.1: Technology is used to explore the Earth System Unit 1 Section 1.4: Technology is used to map Earth Unit 2 Section 3.3: Technology improves the ways people use energy
McDougal Littell Science Integrated Course 2	Unit 4 Section 5.3: Design a Machine Unit 5 Section 2.3: Design an Electronic Communication Device
McDougal Littell Science Integrated Course 3	Unit 5 Section 5.3: Modern Genetics Uses DNA Technology

## Complete Listing of web-reviewed Textbooks

### Glencoe/McGraw-Hill/Merrill Co:

Physics Principles & Problems

Biology (Mader)

Biology (Raven)

Chemistry (Chang)

Chemistry (Silberberg)

Environmental Science (Cunningham)

Environmental Science (Enger)

Human Genetics (Lewis)

Human Genetics (Lewis) Concepts & Connections

Inquiry Into Life

Integrated Principles of Zoology

Marine Biology

Zoology

Glencoe Biology

Biology: the Dynamics of Life

Biology: An Everyday Experience

Biology: Living Systems

Biology: A Community Context

BSCS: A Molecular Approach

Human Biology

Chemistry: Matter & Change

Chemistry: Concepts & Applications

Earth Science: Geology, the Environment, and the Universe

Middle School 15-book Series:

- Animal Diversity
- Astronomy
- Chemistry
- Earth Materials & Processes
- Ecology
- Electricity & Magnetism
- From Bacteria to Plants
- Human Body Systems
- Life's Structure & Function
- Motion, Forces, and Energy
- The Air Around You
- The Changing Surface of Earth
- The Nature of Matter
- The Water Planet
- Waves, Sound, and Light

Glencoe Science Level Red

Glencoe Science Level Green

Glencoe Science Level Blue

Earth Science

Glencoe Science: An Introduction to the Life, Earth, & Physical Sciences

Introduction to Physical Science

Life Science

**Holt**

Holt Science and Technology: Life Science  
Holt Science and Technology: Earth Science  
Holt Science and Technology: Physical Science  
SciencePlus Technology and Society: Green  
SciencePlus Technology and Society: Red  
SciencePlus Technology and Society: Green  
Holt Science Spectrum: Physical Science  
Modern Biology  
Biology Principles & Explorations  
Holt Biology: Visualizing Life  
Holt Chemistry  
Modern Chemistry  
Holt Chemistry: Visualizing Matter  
Holt Physics  
Holt Environmental  
Holt Earth Science

**Prentice Hall**

Science Explorer: Life Science  
Science Explorer: Earth Science  
Science Explorer: Physical Science  
Physical Science: Concepts in Action with Earth & Space Science  
Chemistry  
Biology  
Biology: Exploring Life  
Conceptual Physics

**Houghton Mifflin Company/McDougal Littell/D.C. Heath**

Middle School Science Modules:

- Life Science/Cells and Heredity
- Life Science/Life Over Time
- Life Science/Diversity of Living Things
- Life Science/Ecology
- Life Science/Human Biology
- Earth Science/Earth's Surface
- Earth Science/The Changing Earth
- Earth Science/Earth's Waters
- Earth Science/Earth's Atmosphere
- Earth Science/Space Science
- Physical Science/Matter and Energy
- Physical Science/Chemical Interactions
- Physical Science/Motion and Forces
- Physical Science/Waves, Sound, and Light
- Physical Science/Electricity and Magnetism

McDougal Littell Life Science (Middle School)

McDougal Littell Earth Science (Middle School)

McDougal Littell Physical Science (Middle School)

McDougal Littell Science Integrated Course 1  
McDougal Littell Science Integrated Course 2  
McDougal Littell Science Integrated Course 3  
Earth Science (High School)  
World of Chemistry  
Chemistry (Zumdahl)  
Introduction to Chemistry (Zumdahl)  
Essential of General Chemistry  
General Chemistry

### **Introductory Engineering Textbooks**

“Engineering Your Future – A Project Based Introduction to Engineering” Great Lakes Press

“Engineering Our Digital Future”\* Pearson Prentice Hall

“Engineering The Future: Designing the World of the 21<sup>st</sup> Century” Museum of Science (MOS.org)

\* Part of the Infinity Project Curriculum